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BREEDING ECOLOGY OF WHITE-WINGED DOVES IN A RECENTLY COLONIZED URBAN ENVIRONMENT

MICHAEL F. SMALL,[1,3] CYNTHIA L. SCHAEFER,[1] JOHN T. BACCUS,[1] AND JAY A. ROBERSON[2]

ABSTRACT.—Using field-implanted subcutaneous radio transmitters, we monitored the breeding biology of White-winged Doves (*Zenaida asiatica*) in a recently colonized urban area (Waco, Texas). We implanted transmitters in June 2002 (n = 39; 16 males, 23 females) and February and March 2003 (n = 40; 17 males, 17 females, 6 unknown sex), and tracked radio-tagged doves every 3rd day until transmitters no longer functioned (90–120 days). We tracked 26 doves to 36 nests in nine tree species. The maximum number of nesting attempts was four. Nest success of first and second nesting attempts was 62 and 24%, respectively, and overall nest success for both years combined was 52%. Mean nest height—as a proportion of tree height—ranged from 0.31 to 0.75. Urban White-winged Doves had an extended breeding season; nesting attempts occurred both before and after the traditional dove breeding period in native brush habitats of the lower Rio Grande Valley of Texas. Field-implantation of subcutaneous radio transmitters was a viable technique for monitoring nesting activities of White-winged Doves. *Received 20 August 2004, accepted 13 March 2005.*

Over the last 40 years, the distribution of White-winged Doves (*Zenaida asiatica*) has undergone substantial change (Schwertner et al. 2002). Until the mid-1970s, the breeding range in Texas was limited mainly to four counties (Cameron, Starr, Hidalgo, and Willacy) in the lower Rio Grande Valley (LRGV) at the extreme southern tip of the state (Cottam and Trefethen 1968, George et al. 1994). Since then, White-winged Doves have been expanding their range northward; the species has been recorded in Canada (Rogers 1998), with breeding documented as far north as Kansas (Moore 2001). The majority of breeding individuals in the United States, both currently and historically, resides in Texas (George et al. 1994).

White-winged Dove populations have increased substantially over the past 20 years, but only 16% of the Texas population now occurs in the LRGV (G. L. Waggerman pers. comm.). Large breeding populations of White-winged Doves have become established in central Texas, with numerous smaller, satellite populations occurring throughout the state. Concurrent with the northward range expansion, White-winged Dove populations are now concentrated in urban areas (West et al. 1993). This represents a dramatic shift in habitat use away from thorn scrub and riparian woodlands of the Tamualipan biotic province (Blair 1950) that characterizes the LRGV (West et al. 1993, Schwertner et al. 2002).

Loss of native habitat and extensive agricultural and industrial development in the LRGV have influenced the distribution of White-winged Doves in Texas (Hayslette et al. 1996). From 1900 to 1950, about 95% of the historic, native breeding habitat was converted for human uses, resulting in significant loss of old-growth woodlands and water diversions from the Rio Grande and Arroyo Colorado (Kiel and Harris 1956, Cottam and Trefethen 1968). In addition, severe freezes occurring in 1951, 1962, 1983, and 1989 decimated citrus groves that White-winged Doves had used increasingly as nesting sites, most likely in response to loss of native habitat (Cottam and Trefethen 1968, George et al. 1994).

A substantial proportion of White-winged Doves concentrating in urban areas north of the LRGV are non-migratory (George 1991, West et al. 1993, Hayslette and Hayslette 1999). Anecdotal evidence suggests that an extended breeding season by non-migratory doves could lead to increased recruitment, with individuals producing clutches before and after the traditional nesting period (Hayslette and Hayslette 1999).

The objective of our study was to document habitat use and productivity of White-winged Doves breeding in a recently colonized urban

[1] Dept. of Biology, Texas State Univ., San Marcos, TX 78666, USA.
[2] Texas Parks and Wildlife Dept., 4200 Smith School Rd., Austin, TX 78744, USA.
[3] Corresponding author; e-mail: doveman@centurytel.net

environment. To track doves, we used subcutaneously implanted radio transmitters. This is the first radiotelemetry-based study of White-winged Dove breeding ecology in a metropolitan area.

METHODS

We conducted our study in Waco, Texas (McLennan County), because of its northern location and relatively recent colonization by White-winged Doves; dove densities are high and the human population (202,983; U.S. Census Bureau 2000) provides potential sources of food, water, and habitat. White-winged Doves were first recorded in Waco on the Audubon Christmas Bird Count in 1990, and they were first observed breeding there in 1993. In 1999, 2001, 2002, and 2003, Texas Parks and Wildlife Department personnel conducted call-count surveys of White-winged Doves in Waco, subsequently deriving a population estimate of approximately 70,000 doves.

Our study area boundary was the city limits of Waco. White-winged Doves preferentially congregated in older (>30 years) neighborhoods with relatively high densities of mature ornamental trees. The dominant tree species, which accounted for the majority of the canopy, were oaks (*Quercus* spp.) and pecan (*Carya illinoinensis*). We also observed that, with the exception of fall feeding flights to areas outside of Waco, doves obtained food and water locally, primarily from anthropogenic sources.

We trapped White-winged Doves using standard walk-in wire funnel traps (Reeves et al. 1968) baited with a 2:1 mixture of chicken scratch and black-oil sunflower seeds (Purina Corp., St. Louis, Missouri). In June 2002, we surgically implanted subcutaneous transmitters in 39 White-winged Doves (16 males, 23 females), and, in February and March 2003, we implanted transmitters in another 40 doves (17 males, 17 females, 6 unknown sex). We monitored doves from 10 July to 4 September in 2002 and from 31 March to 18 June in 2003. Gender was determined using an infant nasal speculum to examine the cloaca and identify conical papillae in males or an oviduct opening in females (Miller and Wagner 1955, Swanson and Rappole 1992). We performed transmitter implants in the field using a portable anesthesia machine and mobile surgical lab (Small et al. 2004). Implanted individuals were released after they had completely regained a coherent state with no signs of impairment. Transmitters (Advanced Telemetry Systems, Isanti, Minnesota) weighed 3.7 g (approximately 2.0% of body weight) and were 25 × 14 × 7 mm with an external, 16-cm-long whip antenna. All research was conducted in accordance with the Texas State University Institutional Animal Care and Use Committee, approval number 5QEKCT02.

Using a vehicle-mounted, omni-directional antenna and a handheld, four-element, directional yagi antenna (White and Garrott 1990), we tracked radio-tagged doves for the duration of transmitter function (50–80 days). We documented nesting (time, date, location, and status) and habitat (tree species, nest height, and tree height) parameters. We monitored active nests every 3rd day using binoculars, and, when feasible, an extendable fiberglass pole with a mirror (Parker 1972). We calculated nest success rates using Mayfield methods (Mayfield 1961, 1975). For reasons discussed in Johnson (1979), we did not use the Mayfield-40% method (Miller and Johnson 1978) or the maximum-likelihood method. The Mayfield-40% method might have proven more appropriate if the mean nest-visitation rate was ≥15 days; the maximum-likelihood method is subject to bias unless sample sizes are large (Miller and Johnson 1978). We calculated standard errors and 95% confidence intervals for nesting success following Johnson (1979).

Both male and female White-winged Doves participate in nest building, incubation, and brooding; nests are constantly attended by at least one adult (Schwertner et al. 2002). Because of constant nest attendance, we assumed equal probability of egg and nestling survival. Because White-winged Doves in urban areas do not reuse nests (White-winged Doves produce multiple clutches; Gray 2002, Schaefer 2004), there was no bias due to age heterogeneity of nests. We were unable to establish hatching dates because most nests were too high.

We considered a nest active if it was attended by an adult, and we considered it successful if at least one young fledged from the nest. Time to fledging was based on a 14-day

TABLE 1. Mayfield nest success (standard error) and 95% confidence intervals, by nest attempt and year, Waco, Texas, 2002–2003.

Nest attempt/year	No. exposure days	No. nests	No. nests failed	Nest success (SE)	95% CI
1st/2002	245	13	3	0.708 (0.007)	0.701–0.715
1st/2003	217	12	5	0.521 (0.010)	0.510–0.531
All/2002	264	14	4	0.652 (0.008)	0.644–0.660
All/2003	296	20	9	0.421 (0.010)	0.411–0.431
1st/2002, 2003	462	25	8	0.613 (0.006)	0.607–0.619
2nd/2002, 2003	70	6	3	0.293 (0.024)	0.269–0.318
All/2002, 2003	560	34	13	0.518 (0.006)	0.517–0.524

incubation period and a 14-day brooding period (Cottam and Trefethen 1968, Schwertner et al. 2002). Nest success was calculated as $(1 - [\text{number of nests failed/number of nest exposure days}])^{28}$. The exponent of 28 represents combined egg and nestling exposure periods of 14 days each (Schwertner et al. 2002). Standard errors were calculated as the square root of $1/([\text{number of nest exposure days}]^3/[\text{number of nest exposure days} - \text{number of failed nests}][\text{number of failed nests}])$.

We tested for differences in nest success between years for first nesting attempts and for all attempts combined, and we tested for differences between first and second nesting attempts for both years combined. Nest success was considered significantly different if there was no overlap in 95% confidence intervals (Sokal and Rohlf 1995). Nest success for third and fourth nesting attempts was not calculated separately because of small sample size (n = 2). One first nest attempt in 2002 was excluded from analysis because young fledged on the day we located the nest.

RESULTS

From 10 July to 4 September 2002, we tracked 14 of the 39 radio-tagged White-winged Doves (8 males, 6 females) to 15 nests. From 31 March to 18 June 2003, we tracked 12 of the 40 radio-tagged doves (7 males, 3 females, 2 unknown sex) to 20 nests, including 1 pair in which both individuals were radio-tagged. In 2002, seven males and six females nested once and one male nested twice. In 2003, five males and two females nested once, two males and one bird of unknown gender nested twice, one bird of unknown gender nested three times, and one female nested four times.

We located the 35 nests in nine tree species, primarily in pecan (48.5%) and sugarberry (*Celtis laevigata*; 17%). The remaining 34.5% occurred in live oak (*Quercus virginiana*), cedar elm (*Ulmus crassifolia*), chinaberry (*Melia azedarach*), crapemyrtle (*Lagerstroemia indica*), pomegranate (*Punica granatum*), Texas oak (*Q. buckleyi*), and glossy privet (*Ligustrum lucidum*). Mean nest height, as a proportion of tree height, was 0.55 in pecan, 0.41 in sugarberry, and 0.45 in the other seven tree species.

Nest success was 0.652 in 2002, 0.421 in 2003, and 0.518 for both years combined (Table 1). Nest success for first nesting attempts and for all nesting attempts combined was significantly lower in 2003 than in 2002. Nest success for second nesting attempts was significantly lower than for first nesting attempts (both years combined). Nest success for all nests for both years was 0.518 (SE = 0.006; Table 1).

DISCUSSION

White-winged Doves in Waco, Texas, have an extended breeding season. Historically, May to mid-August has been the period of greatest White-winged Dove breeding activity, particularly in the LRGV (Cottam and Trefethen 1968, George et al. 1994, Schwertner et al. 2002). However, in five newly colonized urban populations in Texas, hatching-year White-winged Doves have been observed every month of the year (MFS pers. obs.).

Twenty-three percent of radio-marked White-winged Doves attempted more than one nesting, compared with 39% reported for Kingsville, Texas (Gray 2002). In 2003, one of our radio-marked females nested four times, the first and fourth attempts having been successful (Schaefer et al. 2004). Cottam and Trefethen (1968) also report multiple nestings during the breeding season; others list the mean as two broods per season (Schwertner et al. 2002).

Overall nest success was 51.8% compared with 58% (Hayslette and Hayslette 1999) and 53% (Gray 2002) in Kingsville, Texas, and 39 to 73% for San Antonio, Texas (West et al. 1993). Earlier monitoring of nests in 2003, prior to the historic peak-breeding time of July (Cottam and Trefethen 1968, Schwertner et al. 2002), may have been the reason for the significant difference in nesting success between years in Waco. When we first began monitoring in 2003, nest trees had not reached maximum foliage development, which resulted in less protective cover and possibly in increased nest failure from exposure to adverse weather and potential predators.

The majority of nests were located in deciduous trees. Nest-tree species were similar in growth form to woodland riparian species native to areas traditionally used by nesting White-winged Doves in the LRGV (Cottam and Trefethen 1968, Schwertner et al. 2002) and Kingsville, Texas (Gray 2002). In urban areas, shade trees such as pecan, live oak, and hackberry are important species for nesting for White-winged Doves (Nilsson 1943, Cottam and Trefethen 1968, West et al. 1993). Although they now nest outside the LRGV—possibly due, in part, to habitat loss (Purdy and Tomlinson 1991)—White-winged Doves seem to select nest trees with growth forms and habits similar to those of the LRGV (Hayslette et al. 1996). The nest heights that we observed—the middle one-third of the tree—were consistent with those recorded in other studies (Small et al. 1989, Gray 2002). Trees less than 3-m high were rarely used for nesting.

Conclusions.—Fragmentation of habitat in the LRGV, primarily due to converting native habitat for agriculture (Purdy and Tomlinson 1991, Brush and Cantu 1998), has resulted in the loss of more than 95% of traditional White-winged Dove breeding habitat in Texas. In addition, changes in water-management practices, increased urbanization, and industrialization have degraded breeding habitat for White-winged Doves (Curtis and Ripley 1975).

The distribution of White-winged Doves in Texas has undergone substantial change over the past 50 years, with the most dramatic changes beginning about 1970 (Schwertner et al. 2002). The primary change in White-winged Dove ecology has been the establishment of numerous new populations resulting from a northward range expansion and concurrent colonizing of urban areas by breeding populations (Small et al. 1989, West et al. 1993). To our knowledge, an increase in breeding range combined with such a dynamic change in fundamental, ontogenetically based behavior are unprecedented in bird species native to the New World. The only other analogous scenario has been the range expansion of the Eurasian Collared-Dove (*Streptopelia decaocto*); in about 1900, the species began a similar expansion of its breeding range northward across Europe from its core population in northern India. Breeding populations now are established as far north as Scandinavia (Hollom et al. 1988, Jonsson 1992, Ehrlich et al. 1994).

The change in the distribution of White-winged Doves has revealed large gaps in our understanding of its natural history and ecology, particularly in recently established populations. Year-round residency, nesting in urban environments, and breeding in every month of the year (Hayslette and Hayslette 1999) are drastic departures from dove behavior exhibited prior to 1950, when the species was primarily restricted to the LRGV of Texas (Cottam and Trefethen 1968, George et al. 1994).

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